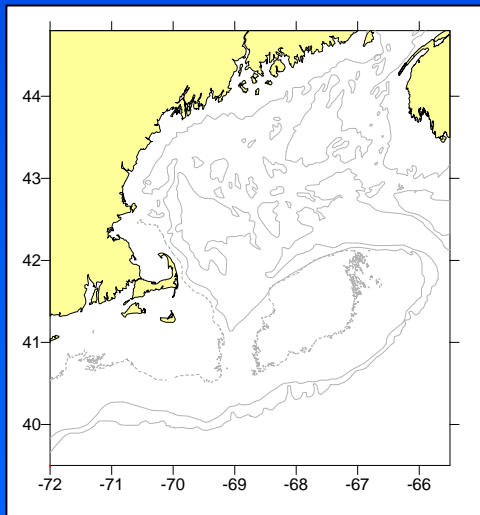


# Recent Environmental Variability in the Gulf of Maine

(...and some implications for the fish)



David Mountain  
Northeast Fisheries Science Center  
Woods Hole, MA

## **Environmental Influence on the fish stocks:**

**Direct – behavior, physiology**

**Indirect - larval food, survival and recruitment  
(‘bottom-up’)**

**“Was it warmer or colder last year?”**

**often is not an easy question to answer!**

**Where?**

**When? (a day, a season, the whole year)**

**For how long? (a day, a season, the whole year)**

**Surface? Bottom?**

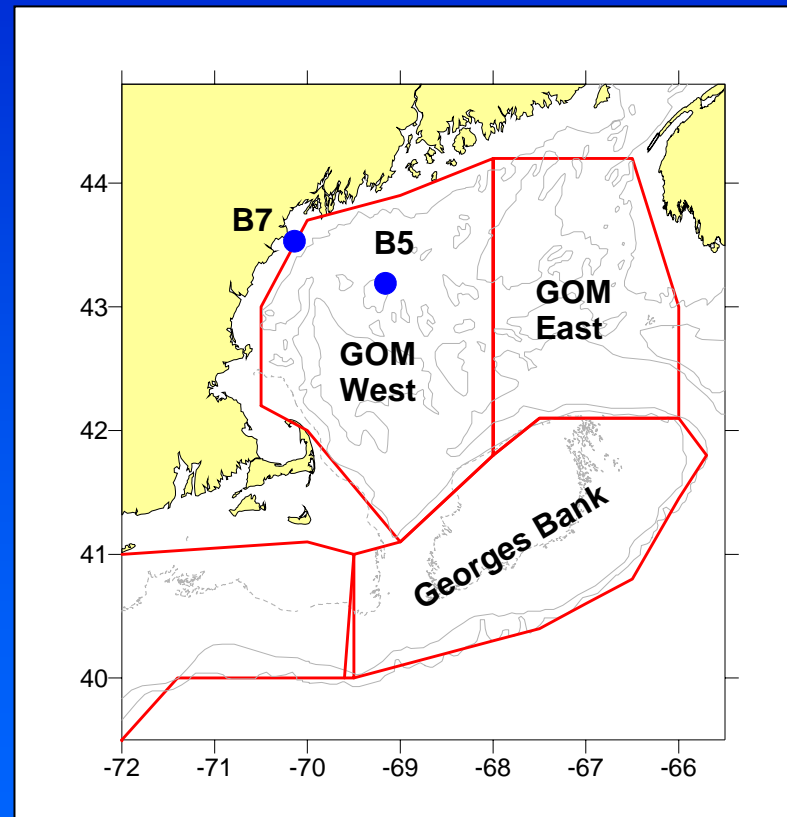
## Outline:

1. Changes in oceanographic conditions over recent years
2. Some basic oceanography of the Gulf of Maine  
(to understand some of those changes)
3. What are the implications for the fish?



# Data Sources

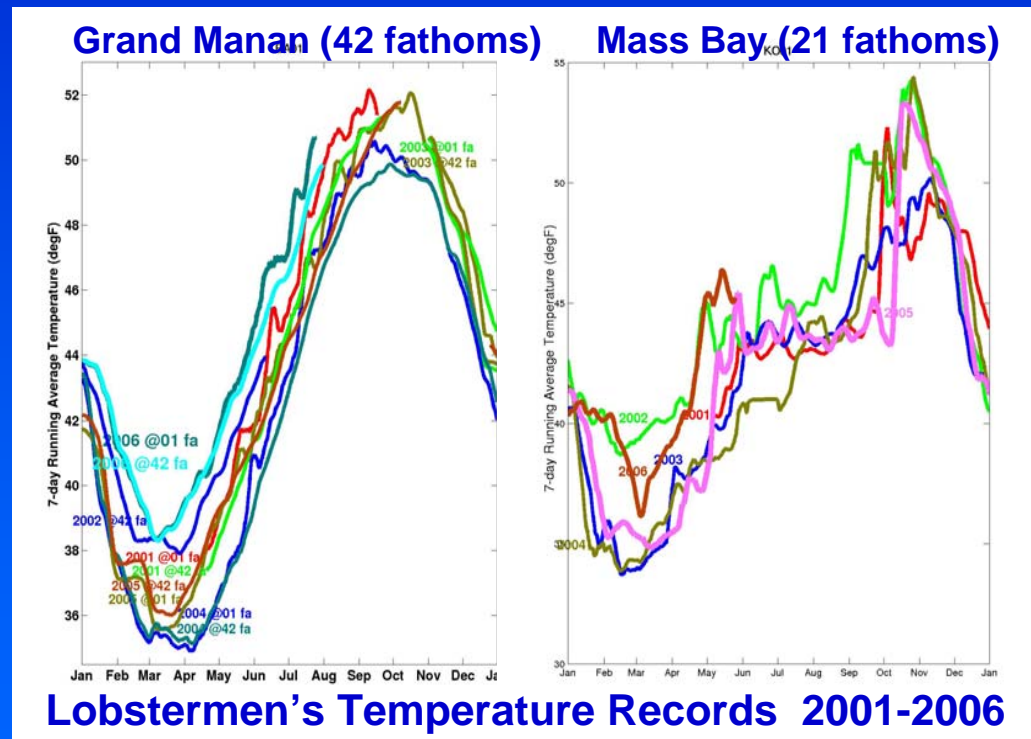
1. NOAA Buoys  
Surface temperature
2. NMFS Surveys  
Temp & salinity  
(EGoM, WGoM, GBk)
3. E-MoLT  
Temperature



# Environmental Monitors on Lobster Traps (E Molt)

(Funded by the Northeast Consortium)

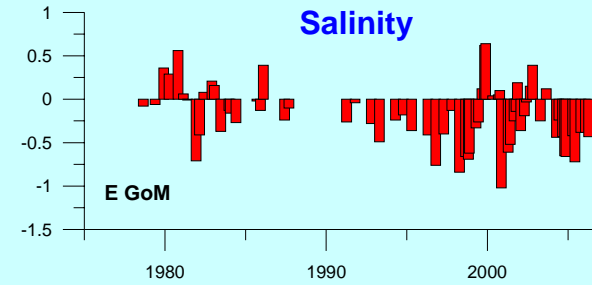
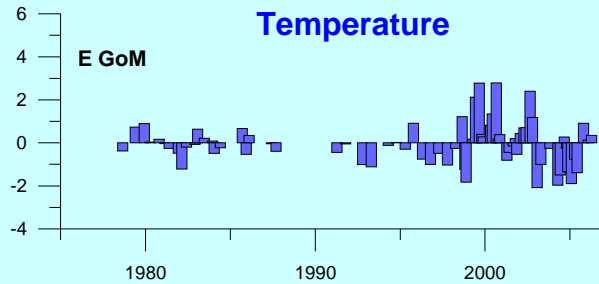
1. Large annual cycle
2. 2004 vs 2006
3. Colder- Warmer vs Shift in timing



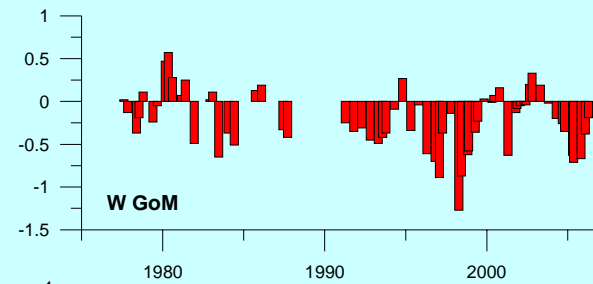
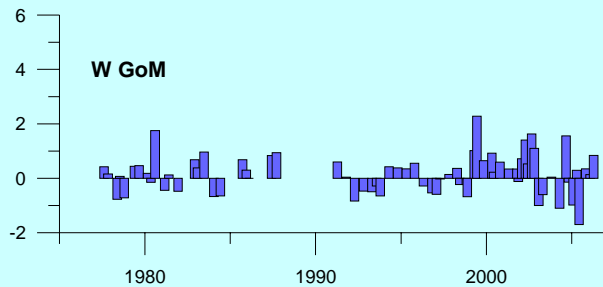
Courtesy of Jim Manning (NEFSC)

# Surface Temperature and Salinity Anomalies (NMFS Surveys)

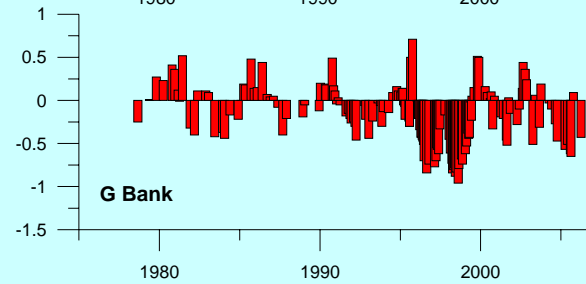
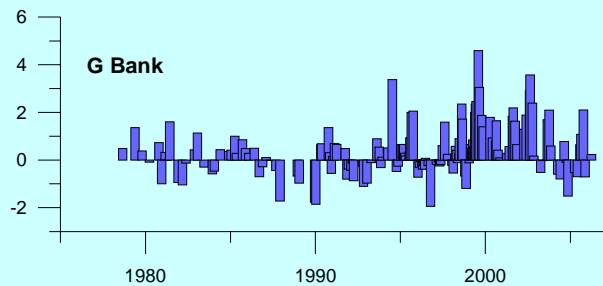
**EGoM**



**WGoM**



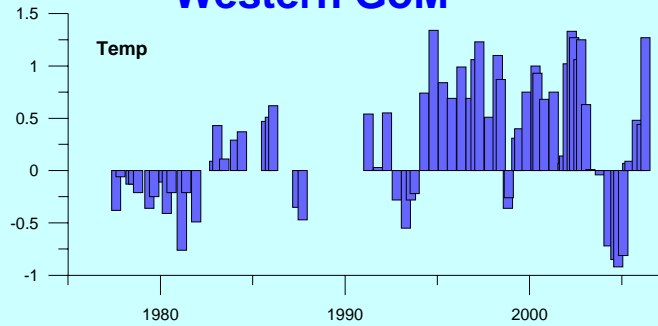
**GBank**



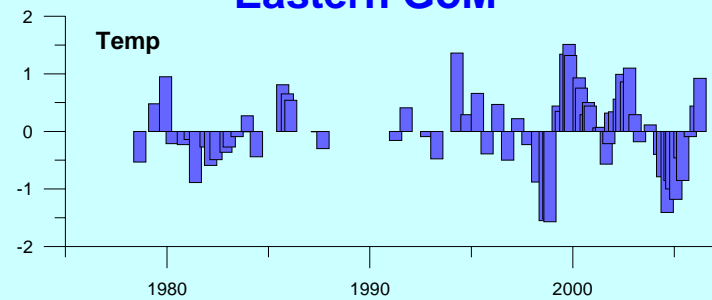
# Bottom Temperature and Salinity Anomalies (NMFS Surveys)

Temp

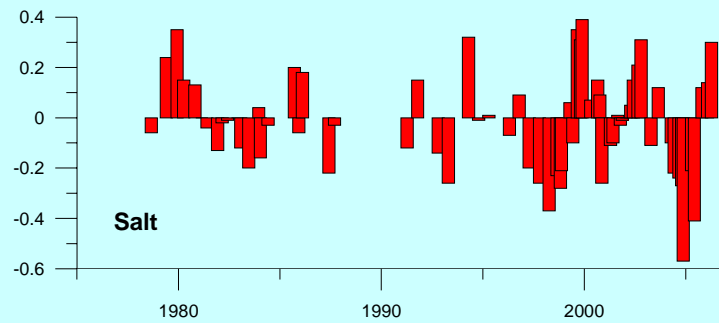
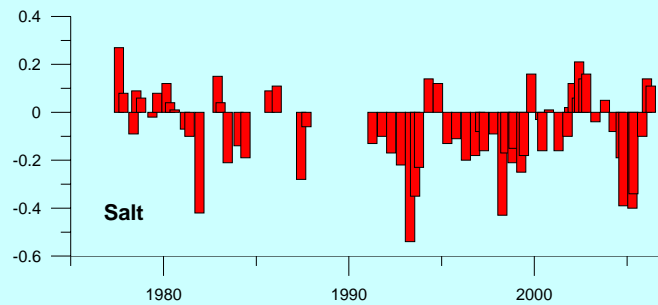
### Western GoM



### Eastern GoM



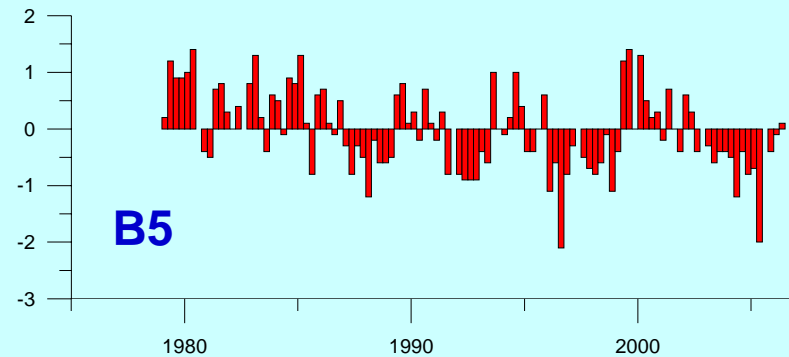
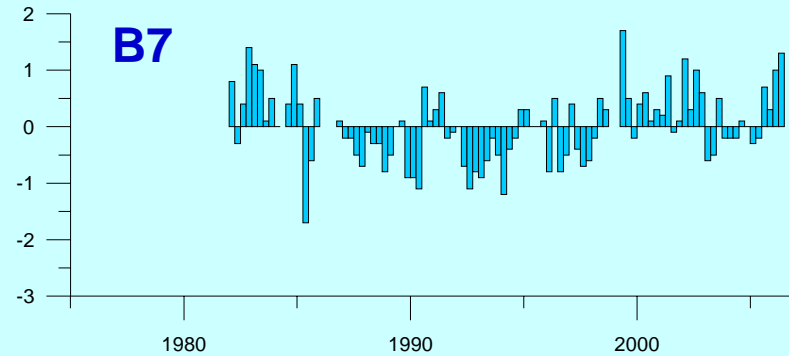
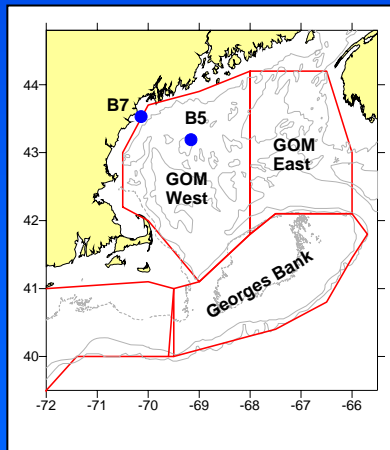
Salt





# NOAA Buoys – Surface Temperature Anomaly by Quarter (J-M, A-J, J-S, O-D)

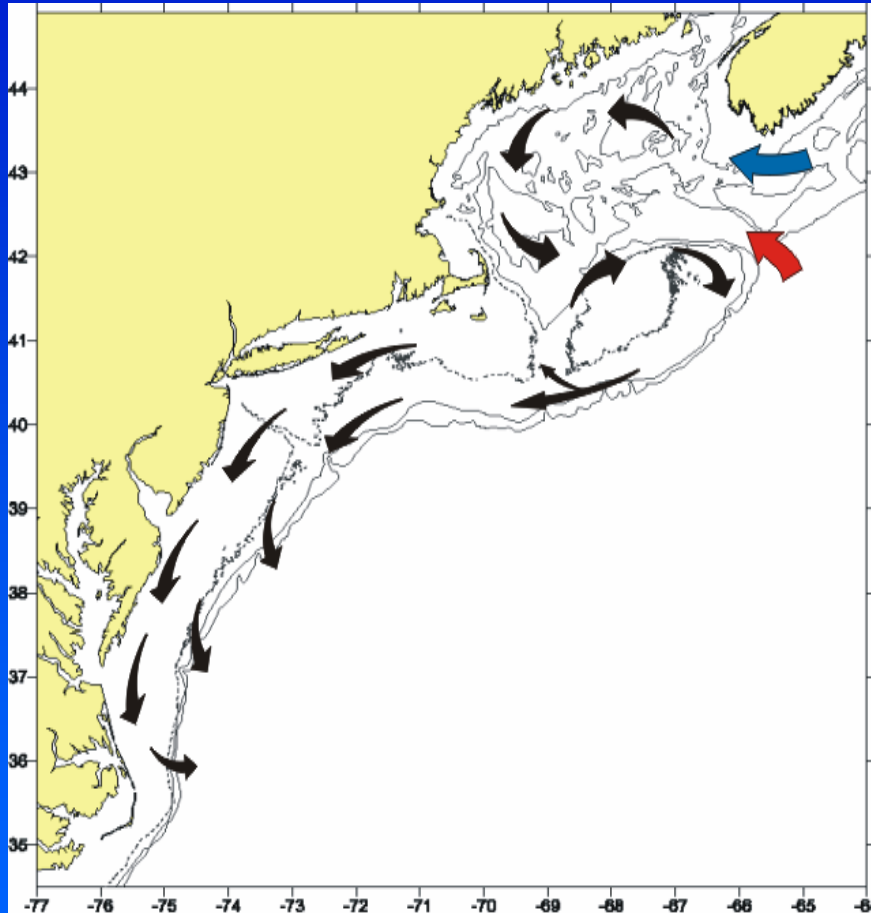
Difference between  
Inshore vs offshore



**So .....**

- 1) low surface salinity event in the 1990's**
- 2) Warmer bottom temperatures in Wilkinson Basin in the 1990's**
- 3) Warmer surface temperatures on Georges Bank since the late 1990's**
- 4) ... otherwise, ups and downs,  
... lots of interannual variability**

# Where does the water come from?

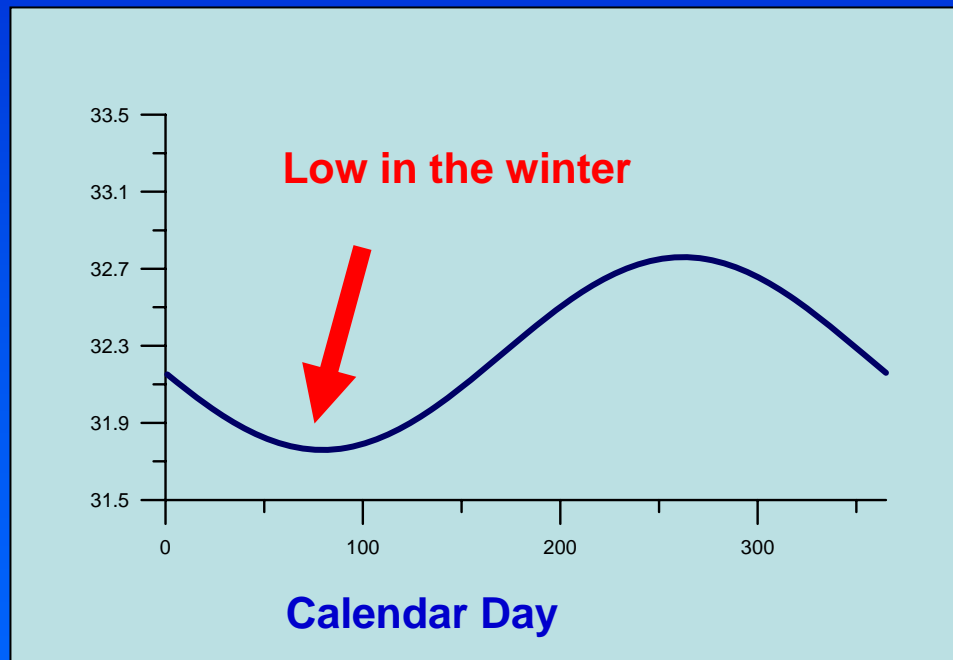
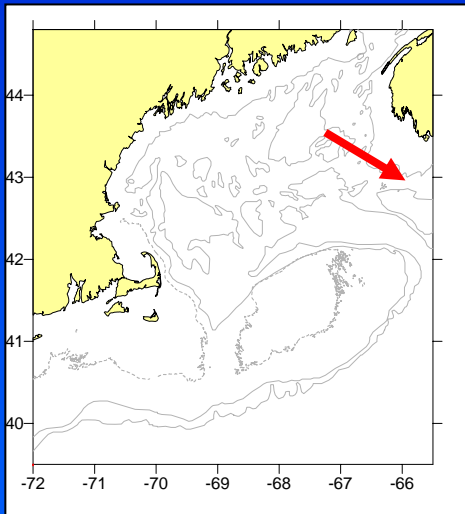


## Origin of the Waters

From two sources:

- 1) Scotian Shelf Water  
(cold, low salinity)
- 2) Slope Water  
(warm, high salinity)

# Cape Sable Salinity Annual Cycle

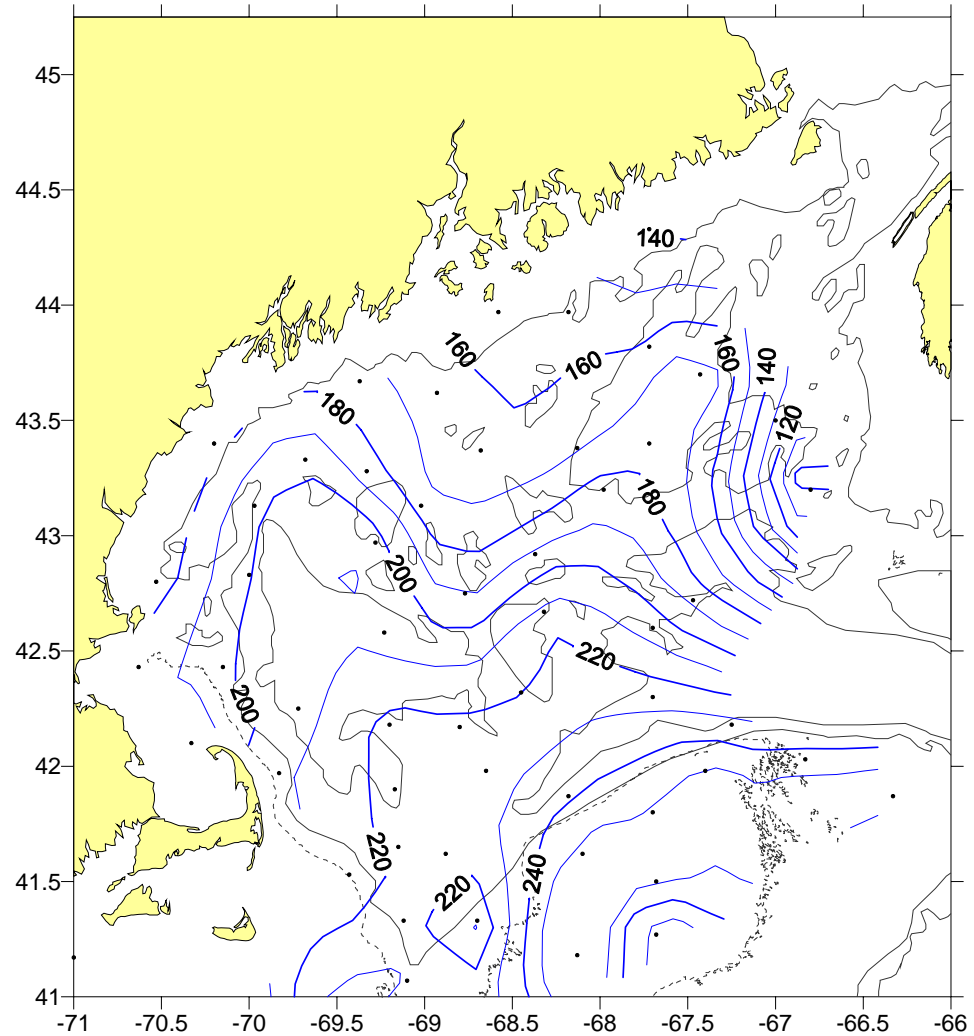


## Calendar Day of Minimum Surface Salinity

**Minimum progresses  
around the Gulf:**

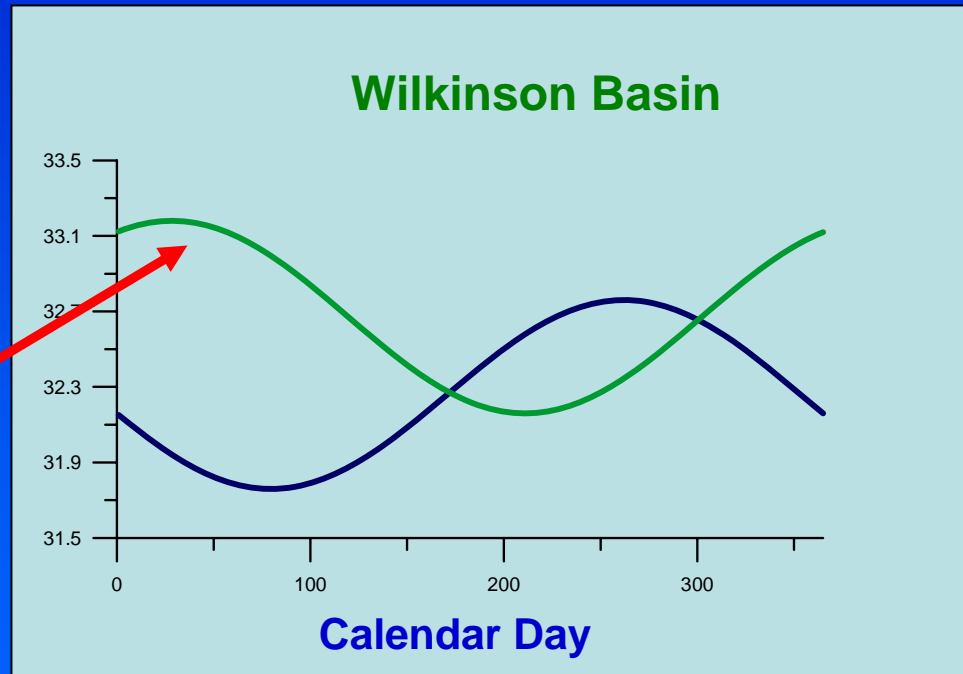
**Cape Sable –  
January/February**

**Wilkinson Basin –  
July/August**

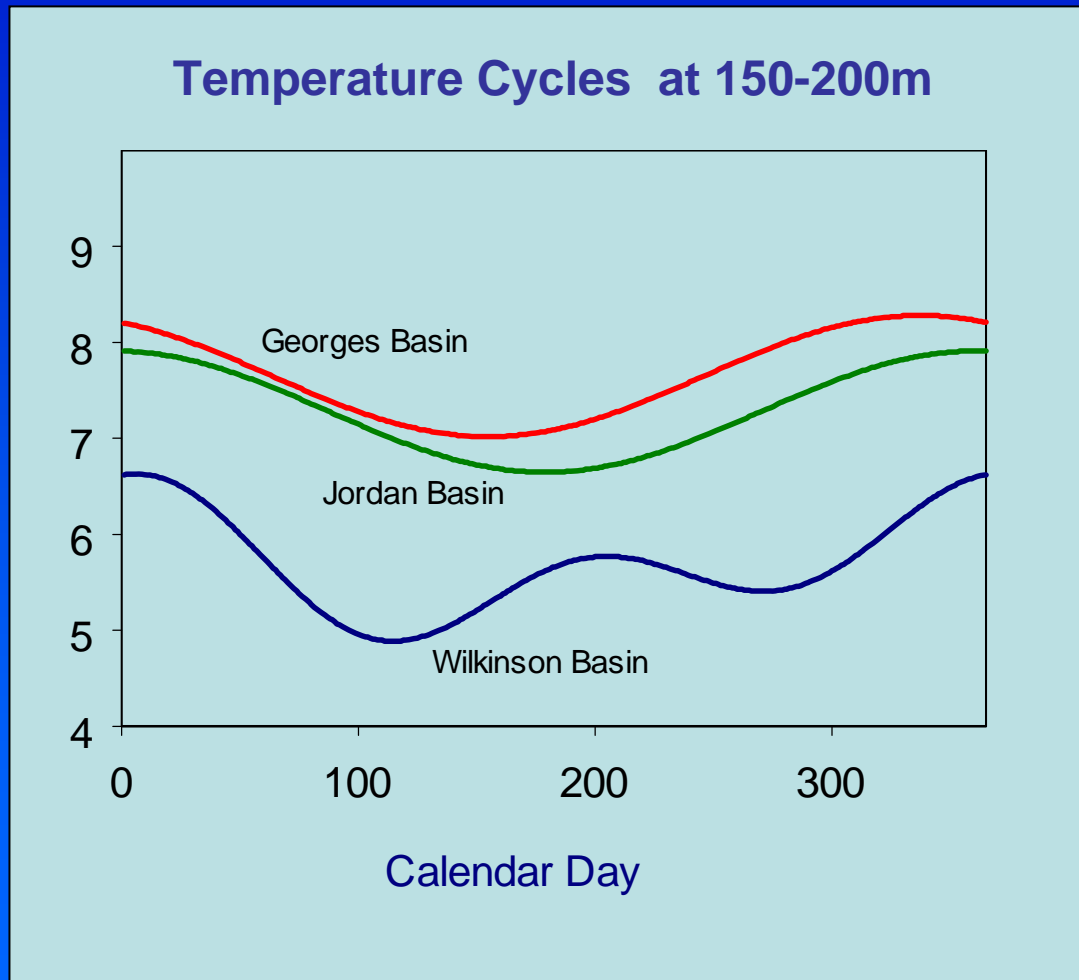


# Wilkinson Basin Surface Salinity Annual Cycle

Maximum in the winter



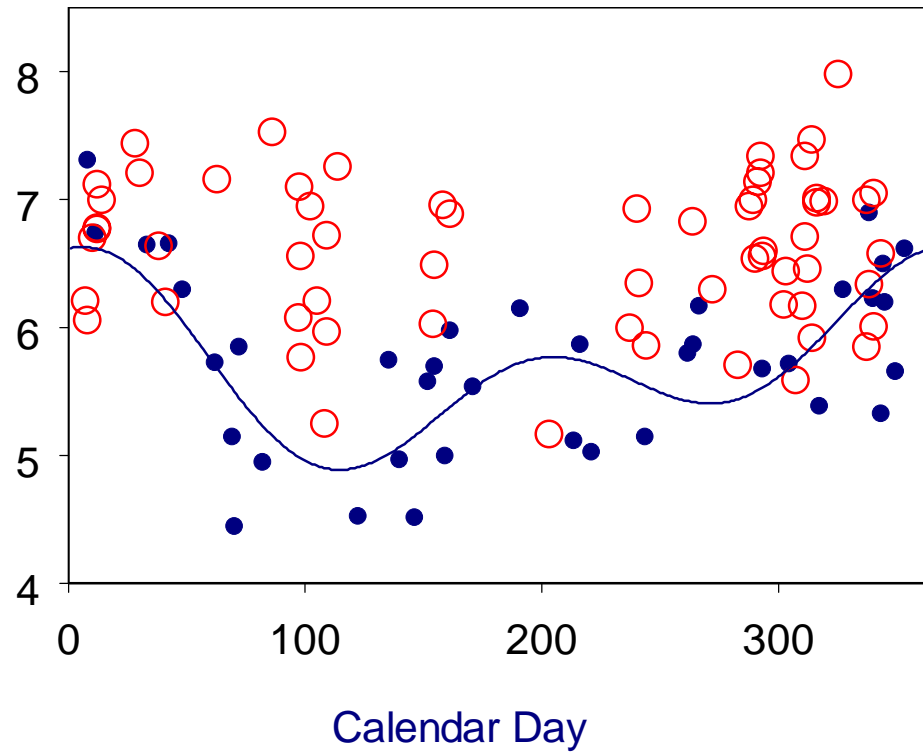
**Wilkinson Basin colder  
because of winter convection  
( & further from NE Channel)**



## Wilkinson Basin 150-200m Temperature

---

1990's warmer!



Blue - MARMAP (1978-1987)  
Red - 1990's



## **Implications for the fish:**

### **Direct effects:**

**No persistent trends in temperature**

**Warmer period in late 1990's - early 2000's**

**Winter 2006 was mild, coastal areas generally warmer**

### **Indirect:**

**Low salinity event may be linked to changes in phytoplankton, zooplankton, larval fish conditions – ecosystem effects, ... but subtle. Active area of study in GLOBEC program**



